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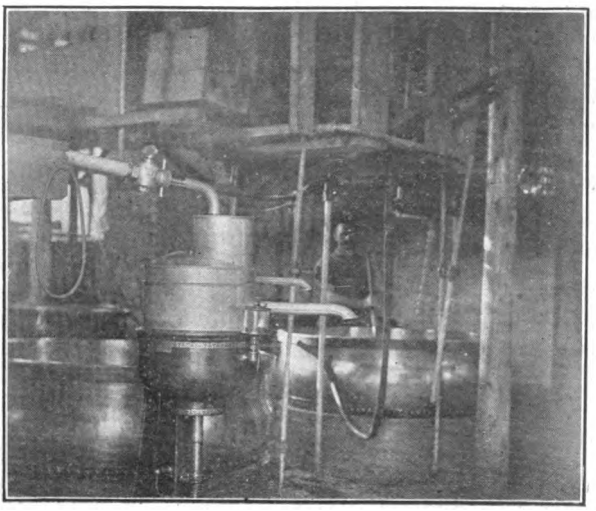


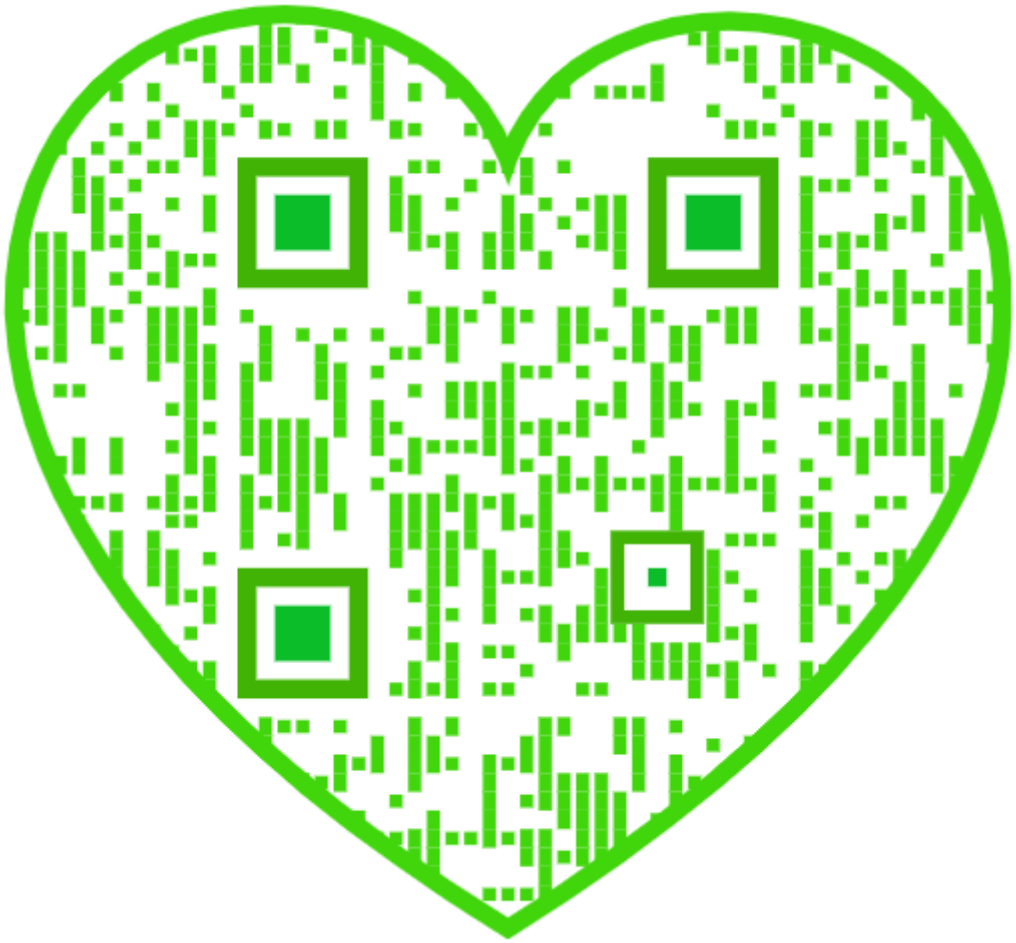
Skimming Whey with Separator.

THE MANUFACTURE OF WHEY BUTTER AT SWISS CHEESE FACTORIES

BY

E. H. FARRINGTON

MADISON, WISCONSIN



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The Manufacture of Whey Butter at Wisconsin Swiss Cheese Factories*

E. H. FARRINGTON

The making of whey butter at a Wisconsin Swiss cheese factory is of secondary importance to the cheese making. As a rule the cheese maker follows antiquated methods of skimming the whey and churning the cream, and obtains about one-half pound of butter for each one hundred pounds of milk. The quality of this butter is often very inferior when considered from the standpoint of table butter, but it is used for cooking purposes, and when it has no rancid flavor there is a good demand for it by bakers and confectioners. When made for cooking or baking the butter is not salted and the "hot process" butter is often packed in jars or tubs and kept until used.

The whey often contains as much as one per cent of butter fat and as it is perfectly sweet, there seems to be no good reason why a better quality of butter should not be made and the amount recovered increased considerably over that usually obtained.

The price of whey butter in Wisconsin does not differ much from that of lard, ranging from eleven to fourteen cents during the summer of 1905.

No reliable record of the total amount of whey butter made in Wisconsin Swiss cheese factories is available, but the books at one factory showed a sale of 3,323 pounds of whey butter which brought $412 as the returns of one year. This is undoubtedly more than the average Swiss factory receives for its whey butter, but there is little question about the possibil-

*Note.—This bulletin is one of a series that is in preparation with especial reference to the promotion of the Swiss cheese industry in Wisconsin. The following bulletin is the only one yet published:

Bulletin 128. A Swiss Cheese Trouble Caused by a Gas-Forming Yeast. H. L. Russell and E. G. Hastings.

ity of at least doubling this figure and increasing the receipts at the three hundred and fifty factories by more than $150,000 annually.

Some factories allow the butter fat in the whey to be returned to the farms where it is fed to calves and pigs. One Swiss factory, visited in July, was receiving ten to twelve thousand pounds of milk daily, and only about twenty-five pounds of whey butter was being made. A little investigation showed that it was possible at this factory to make at least one hundred pounds of butter daily, and the seventy-five

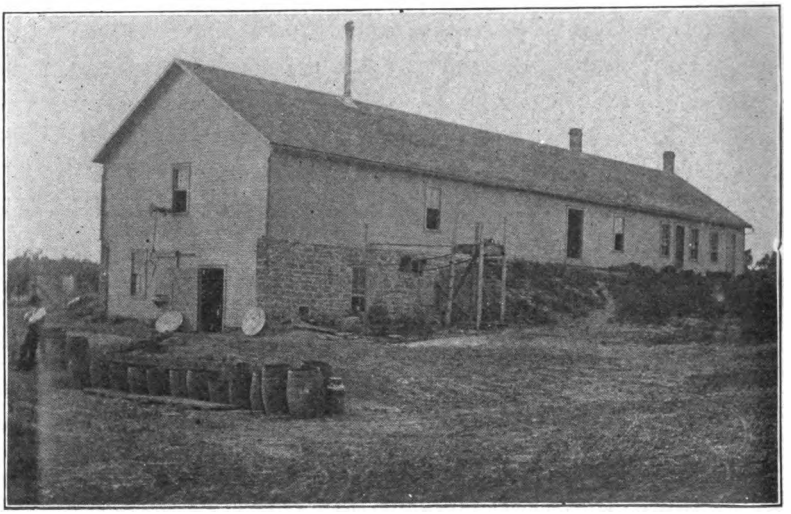

FIG. 1.—A Wisconsin Swiss-cheese factory.

pounds of butter fat which was being fed to the pigs at even fifteen cents per pound was worth $11.25. This is rather expensive stock food for which a substitute of equal feeding value could undoubtedly be obtained at little cost.

These, in brief, are the conditions that have existed ever since the Swiss cheese factories were started many years ago in a few of the southern counties of Wisconsin.

Some idea of the importance of this industry may be gained from the estimate of good authorities who place the value of the Swiss cheese produced each year in this state at $3,500,000. The cheese of this section has gained an enviable reputation

and the farmers have become prosperous by producing milk for making the cheese.

About two years ago the skimming of Swiss whey with a centrifugal power separator was tried in the foreign cheese department at our Dairy School. The cream obtained from this whey was ripened with a starter, then churned, and worked

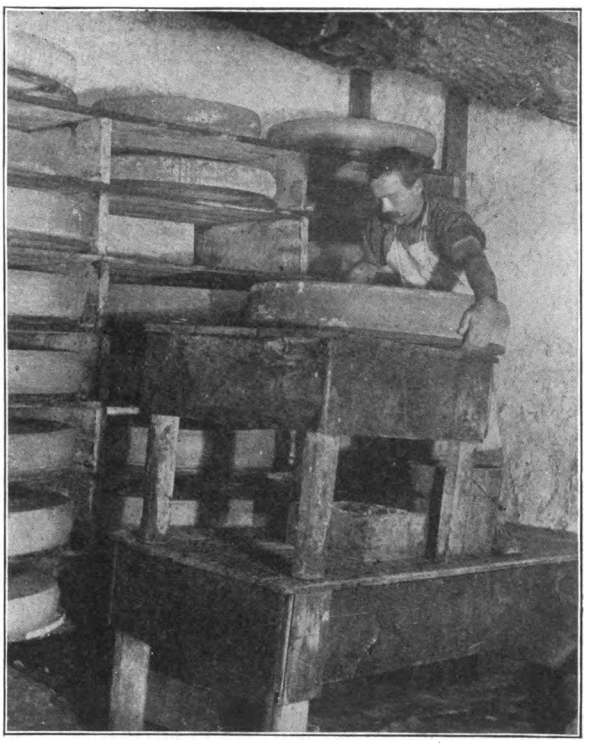

FIG. 2.—Salting and rubbing drum Swiss cheese.

with the appliances commonly used for butter making in dairies and creameries. The quality of the butter obtained was considered as equal to that of creamery butter by many people who examined it. A report of this work spread somewhat throughout the Swiss cheese section of the state, and during the past two years at least ten separators have been placed in Swiss cheese factories for the purpose of skimming the whey and increasing the value of the whey butter ordinarily made at these factories. The Dairy School instructor in foreign

cheese making, who is a Swiss cheese maker, found by traveling among the Swiss factories that the cheese makers were, as a rule, ignorant of modern methods of butter making and on that account were somewhat disappointed in the results obtained even at factories where separators had been introduced. This led us to undertake a study of the whey butter problem, and several factories were visited during July and August, 1905. These included factories where butter is made by the old process as well as those in which separators are used for skimming the whey.

The observations made up to the present time show conclusively that the amount of whey butter commonly recovered can be greatly increased and that the quality of this butter can also be improved. The principal thing which the Swiss cheese factories seem to need, in addition to a separator for skimming the whey, is a cream vat of some sort in which the whey-cream may be ripened and cooled before churning. They also need some different method of working the butter than is common with them.

Before describing in detail the butter making methods which will be helpful to the Swiss cheese maker, a brief outline of the methods of whey butter making now in use may be of interest.

COLD SKIMMING OF THE WHEY.

Whey butter is usually made by either the cold process or by the boiling process. In the cold process the kettle whey is run into large wooden tanks where it is allowed to stand for about twenty-four hours, when the cream is skimmed off with a tin scoop; this is then placed in a small wooden tub and carried into the cheese cellar where it is kept until churned.

The following observations were made at a factory where the cold process was used:

The fresh whey from the kettle was tested and found to contain one per cent butter fat and fifteen one-hundredths (.15) per cent acidity. There were about eighteen hundred pounds of this whey which was run into a wooden tank under a shed at one side of the building. After standing for twenty-four

hours the cream was skimmed from the top of this tank with a tin scoop. Forty pounds of cream were obtained which tested twenty and one-half (20.5) per cent fat, and nine-tenths (.9) per cent acidity. The whey, after the cream was skimmed from it, was run into the patrons' whey barrels. This whey tested three-tenths (.3) per cent fat and seven-tenths (.7) per cent acidity.

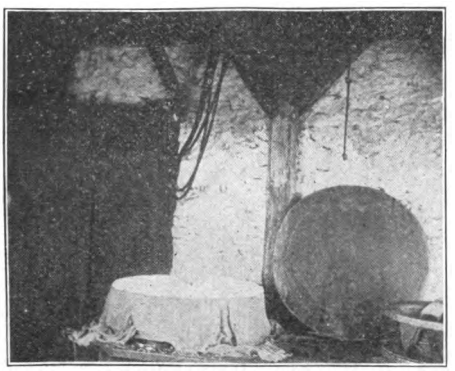

FIG. 3.—A cream ripening can.

These observations show that by the cold process of getting the cream two-thirds of the fat is saved and about one-third goes into the whey barrels, and that both the cream and the whey are about as sour as it is possible for them to get when the skimming is done.

Skimming the whey by the cold process cannot, therefore, be considered a success on account of the extreme sour condition of the whey returned to the farmers and the large loss of butter fat in the whey. The cream also is extremely sour when skimmed and it is very doubtful if butter of a salable quality could possibly be made from it, especially during hot weather.

A sample of this cold-process cream was taken and an analysis* gave the following results:

Butter fat	†19.30 per cent
Curd	1.58 per cent

*The chemical analyses of the samples of cream and butter reported in this bulletin were made by J. C. Brown of the Chemical Department of this Station.

†The difference between the factory test, 20.5, for butter fat and the chemical analysis, 19.30, of this cream is doubtless due to the difficulty in getting fair samples of such cream.

HOT SKIMMING OF THE WHEY.

In the hot process, usually called "boiling the whey," the sweet whey in the kettle is heated to a temperature of about 64° R. (176° F.). The heating begins soon after the cheese is taken out of the kettle.

The following observations were made at a factory where the cream was separated by the boiling process:

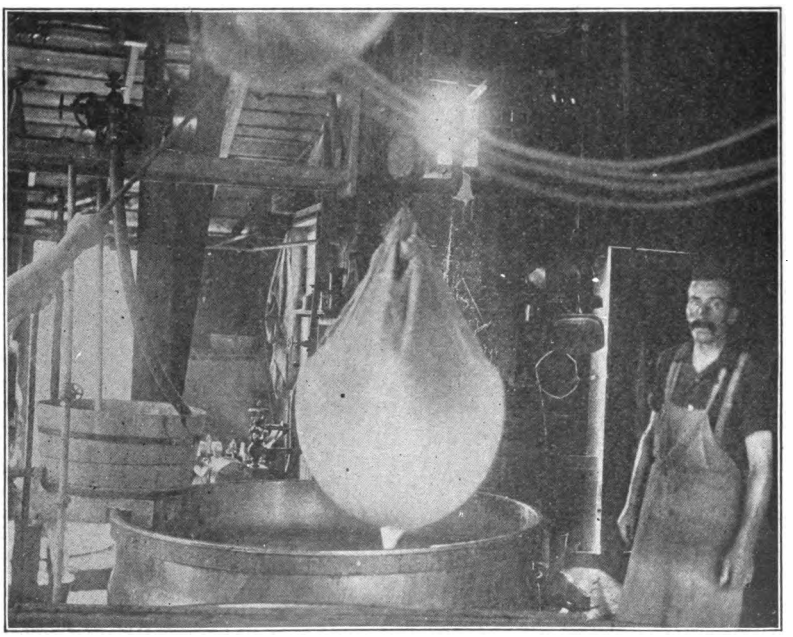

FIG. 4.—Holsting curd from the kettle.

About eighteen hundred pounds of whey in the kettle was heated to 62° R. (172° F.), then two and one-half gallons of very sour whey ("whey vinegar"), was added to it. The whey was constantly stirred and kept near 62° R. for about half an hour. Soon after the heating and stirring began small flakes of white flocculent cream began to rise to the surface; this continued to accumulate until the surface of the kettle was covered with a cream which had very much the appearance of curd that sometimes separates from sour buttermilk.

When the cream all came to the surface, it was dipped out of the hot whey with a wooden scoop and strained into small wooden tubs through a coarse cheese cloth. From the eighteen hundred pounds of whey there was skimmed off one hundred and seventy-five pounds of so-called cream. This was left standing in the tubs for about six hours when a considerable quantity of the whey it contained was drawn off through a hole in the bottom of the tub. There was finally obtained one hundred and twelve pounds of sweet cream which tested ten per cent butter fat.

The whey left in the kettle after the skimming, was tested and found to contain five one-hundredths (.05) per cent fat and fifteen one-hundredths (.15) per cent acidity.

A sample of the hot-process cream gave by a chemical analysis the following results:

Butter fat	12.68 per cent
Curd	4.28 per cent

These figures show that the hot process used for skimming the whey is much superior to the cold process. In these two cases about the same amount of whey (eighteen hundred pounds) was skimmed, and although the per cent of butter fat was the same in both lots of whey there was recoverd by the cold process forty pounds of cream testing twenty per cent, or eight pounds of butter fat, and by the hot process one hundred and twelve pounds of cream testing ten per cent, or eleven and two-tenths pounds of butter fat.

COMPARISON OF RESULTS FROM THE COLD AND THE HOT SKIMMING.

The cream obtained by these two methods of skimming is radically different; that from the cold process is extremely sour when skimmed and a good quality of butter cannot be expected from it; but the cream from the hot process is perfectly sweet when skimmed, and comparatively little butter fat is left in the whey. The hot process, therefore, has the advantage of the cold process in that it recovered in this case forty per cent more butter fat; and the sweet condition of the hot-

process cream makes it possible to produce butter of a good flavor.

Skimming by the hot process requires about as much fuel as is used in heating the milk during the time the cheese is being made in the kettle, while the cold skimming does not require extra fuel. The hot process of skimming makes more work for the cheese maker than the cold skimming, but the increase in both the amount and the quality of the butter obtained by using the hot process will more than offset the difference in fuel and work required by the two methods of skimming.

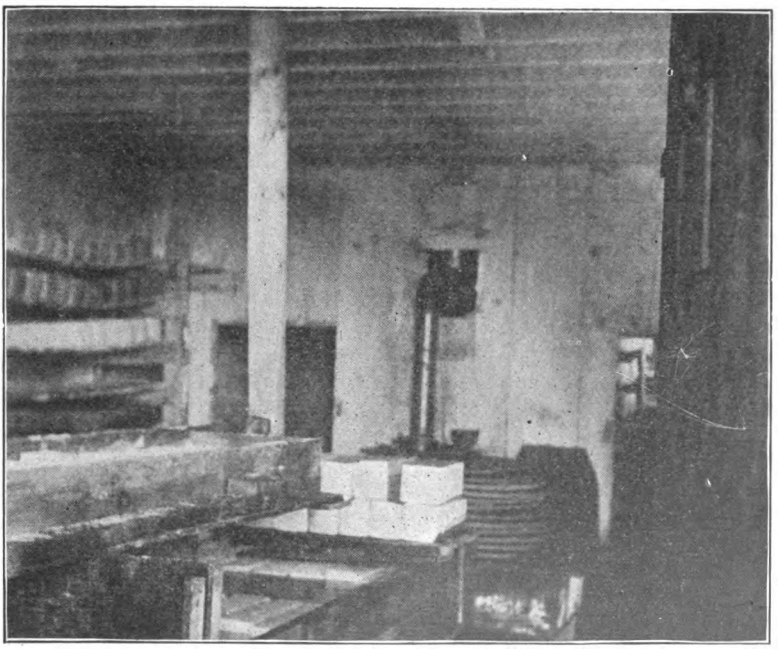

FIG. 5.—Curing cellar and Swiss-cheese salting tank.

At some factories both the hot and the cold processes of skimming are used. The night whey is run into a tank and allowed to stand until the next night when it is skimmed cold. The morning whey is skimmed hot and the cream of both skimmings mixed. These two lots of cream are churned together, but the cold whey-cream is often so sour that it imparts its

bad flavors to the entire churning, and the butter is usually of inferior quality.

A CHEESE FACTORY CHURNING.

Observations were made at a factory where cream from the cold and hot processes were mixed and churned together. One hundred and twelve pounds of cream was obtained from the hot whey; this tested ten per cent and therefore contained eleven and two-tenths pounds of butter fat; it was mixed with forty pounds of cream from the cold whey which tested twenty per cent fat and contained eight pounds of butter fat. The total pounds of butter fat in the one hundred and fifty-two pounds of mixed cream was, therefore, nineteen and two-tenths (19.2) pounds. These two lots of cream were mixed in a tub and stood from 11 A. M. until 5 P. M., when the cream was transferred to the churn. At this time the cream had a temperature of 80° F. and an acidity of one per cent. About one hundred pounds of cold water, having a temperature of 50° F., was then added to the cream in the churn; this reduced the temperature to 72° F. Churning began at 9:15 and was continued until 9:50 P. M. when the soft, greasy butter had accumulated in a layer on the surface of the buttermilk. About twenty pounds of cold water was then added to the churn and after revolving a few times the buttermilk was drawn off; it had a temperature of 72° F., and tested one (1.0) per cent butter fat. About fifty pounds of cold water was again added to the butter in the churn and this was left standing until 9:30 the next forenoon, when the still soft and greasy butter (which looked more like lard than butter) was taken out of the churn.

This butter was scooped into an ash tub and placed in the cheese cellar where it was left for about two hours and then salted and worked.

The butter weighed twenty-four and one-half pounds. Analysis of a sample of it gave the following results:

Water	31.30 per cent
Fat	67.61 per cent
Ash	.05 per cent
Curd	1.04 per cent

CHEESE MAKER'S METHOD OF WORKING THE BUTTER.

The cheese maker's method of working the whey butter is rather crude. He scoops out two handsful of the butter from the tub, places it on a Swiss cheese board, then sprinkles a little coarse cheese salt over it and works the butter with his hands in about the same way as dough is mixed in making bread. This distributes the salt somewhat and a part of the water is worked out. After the butter has all been worked it is placed in sixty-pound tubs, and when one is filled to within one inch of the top, the cover is nailed on and the butter is ready to be sold.

This particular churning of butter, after salting and working, weighed twenty-three and one-half pounds, showing that it had lost one pound by working. A sample of this butter was analyzed and gave the following results:

Water	27.04 per cent
Fat	69.15 per cent
Ash (salt)	2.73 per cent
Curd	1.08 per cent

SUMMARY OF LOSSES BY THE OLD METHODS OF WHEY BUTTER MAKING.

At one factory visited, the two lots of eighteen hundred pounds of whey obtained from the two cheeses made in one day each tested one per cent butter fat; the total whey for the day, therefore, contained thirty-six pounds of butter fat. A large portion of this ought to have been recovered in the whey butter, but the figures already given show that of the eighteen pounds of butter fat in the night whey, only eight pounds were recovered by the cold process of skimming, and of the eighteen pounds in the morning whey, 11.2 pounds of butter fat were recovered, making a total of only 19.2 pounds of butter fat instead of 36 pounds. Here is a loss of nearly one-half the butter fat in the whey by the old methods of skimming.

The losses in churning were also excessive as the twenty-three and one-half pounds of whey butter finally obtained was found to contain 69.15 per cent of butter fat, which, when

multiplied by the pounds of butter, 23.5, gives 16.25 pounds of butter fat recovered, showing a loss of three pounds of butter fat in the buttermilk. This is a little over fifteen per cent of the total butter fat in the cream which was lost in the buttermilk, and the 16.25 pounds of fat recovered in the butter is only forty-four per cent of the total fat in the whey.

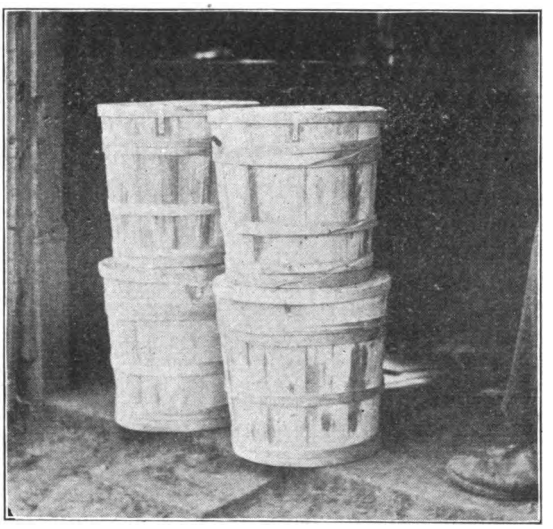

FIG. 6.—Whey butter made in ten days at a factory receiving 4,000 pounds of milk daily. Four sixty-pound tubs.

The records at this factory showed further that four sixty-pound tubs of whey butter were made during ten days in August when the factory was receiving about forty-three hundred pounds of milk per day. This is an average of about twenty-four pounds of butter a day, and it is probable that the butter and the whey were of approximately the same composition as found during the day these tests were made. If such was the case there was recovered only about one-half the total butter in the whey.

The cheesemaker at this factory found by his records that during May, June, and July he had made 1,820 pounds of whey butter from 436,830 pounds of milk; this is about one pound of whey butter from 240 pounds of milk, or a little over four-tenths of one per cent of the milk. If the whey was

eighty per cent of the whole milk and tested one per cent butter fat, the total amount of butter fat in the whey was 3,494 pounds. These figures are further evidence of the excessive losses by the old processes of skimming and churning in Wisconsin Swiss cheese factories.

REDUCING THE LOSSES IN WHEY BUTTER MAKING.

The losses of butter fat in skimming and churning by the old processes of making whey butter can undoubtedly be greatly reduced. The first way which naturally suggests itself for doing this is to skim the whey cleaner than it is possible by either the hot or cold processes. This may be done by a centrifugal separator.

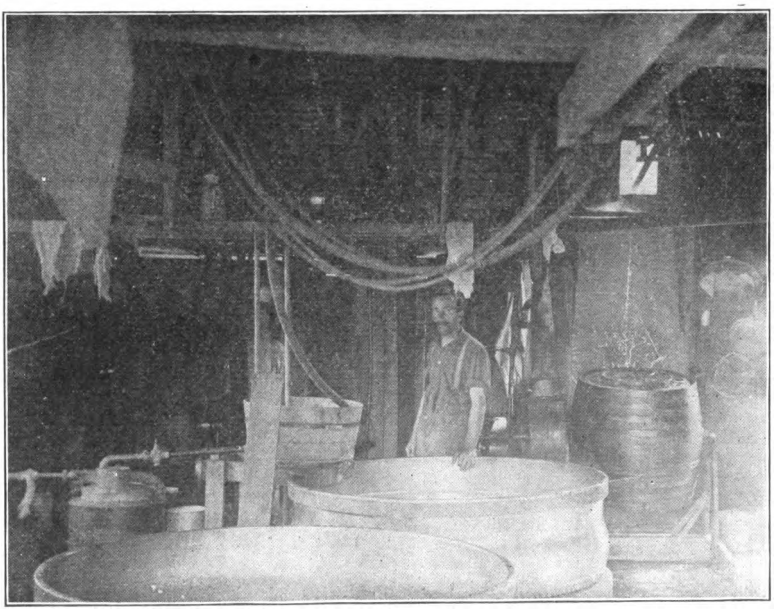

FIG. 7.—Interior of Wisconsin Swiss-cheese factory, showing separator, churn and cheese kettles.

Three factories were visited where separators were used for skimming the whey. At two of these about the same amount of milk, four thousand pounds, was received daily, the same as received at the factory where the whey was skimmed by the

old processes. At one separator factory the whey was skimmed twice. The first skimming gave a cream testing twelve per cent fat. This cream was then run through the separator a second time, the final cream testing fifty-one and one-tenth per cent fat. The skimmed whey after the first separation tested by the Babcock test one one-hundredth (.01) per cent fat, or one small drop about the size of a pin head. This was all that could be obtained by four tests made with a double-neck Babcock test bottle. The second skimmed whey, or that obtained from skimming the first cream, was somewhat richer, testing seven one-hundredths (.07) per cent fat.

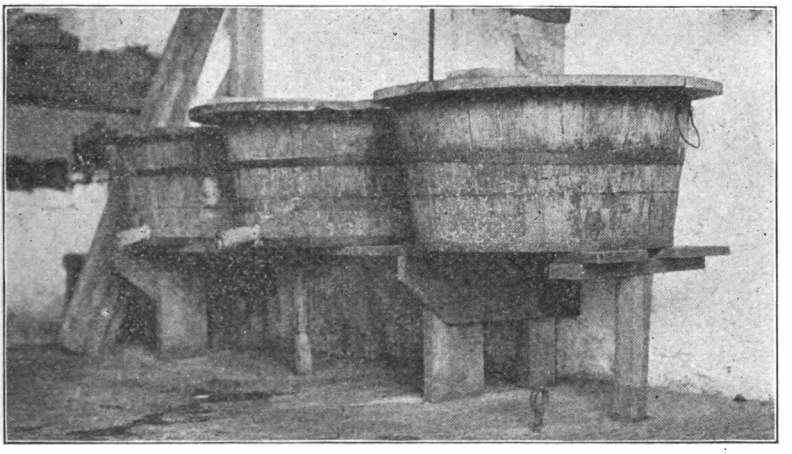

FIG. 8.—A Swiss-cheese maker's cream vat.

At another factory the whey was run through the separator only once. The cream obtained tested twenty-nine per cent fat and the skimmed whey three one-hundredths (.03) per cent fat.

These records made at the two factories show that it is possible to remove nearly all the butter fat from the whey by skimming it with a separator. About two thousand pounds of whey was skimmed per hour and the temperature of the whey during the skimming ranged from 125° to 115° F.

The whey as it comes from these separators is run directly into a tank at one factory and into the patrons' whey barrels

at the other. It is hot and sweet. A test of this whey showed nineteen hundredths (.19) per cent acidity when it was taken by the patrons.

THE OLD METHODS OF HANDLING THE CREAM AND COMPOSITION OF THE BUTTER MADE.

The whey skimming at the two factories having separators was very satisfactory, but no good arrangement had been provided for ripening and cooling the cream. The sweet cream from the separator is placed in small wooden tubs which are set in the cheese cellars and left to sour, the cream from two skimmings being mixed. This is allowed to stand for twenty-four hours and then churned. The churning operations and the butter making are carried on in about the same way as has already been described as the practice at factories where the old processes of skimming are used.

The butter obtained from the separator cream, however, was of an entirely different quality than the old process whey butter, and a larger quantity of butter was recovered. At one factory, a churning of thirty-eight pounds of butter was made from the cream of a morning and a night's skimming where about eighteen hundred pounds of whey was separated each time. A sample of the butter was taken and an analysis gave the following results:

Water	17.44 per cent
Fat	79.78 per cent
Ash (salt)	1.77 per cent
Curd	1.01 per cent

Two samples of separator whey butter obtained at another factory were also analyzed and the following results obtained:

	I.	II.
Water	16.08 per cent	16.36 per cent
Fat	81.82 per cent	80.32 per cent
Ash (salt)	1.29 per cent	2.52 per cent
Curd	.81 per cent	.80 per cent
	100.00 per cent	100.00 per cent

These figures show that separator whey butter may correspond in composition very closely with creamery and dairy butter. The amount of water is near the legal limit of sixteen

per cent, but the quality of this butter was decidedly superior to that made by the old process. The separator whey butter at this factory had been sold for nineteen cents per pound and after deducting the freight and commission for selling, gave a net price of seventeen and one-half cents per pound. The old process whey butter was selling at this time for eleven to thirteen cents per pound.

Samples of whey butter were taken from another factory where both the cold and the hot processes of whey separation were used. These were analyzed and the following results obtained:

	Hot process.	Cold process.
Water	22.22 per cent	21.48 per cent
Fat	76.20 per cent	77.00 per cent
Ash	.55 per cent	.72 per cent
Curd	1.03 per cent	.80 per cent
	100.00 per cent	100.00 per cent

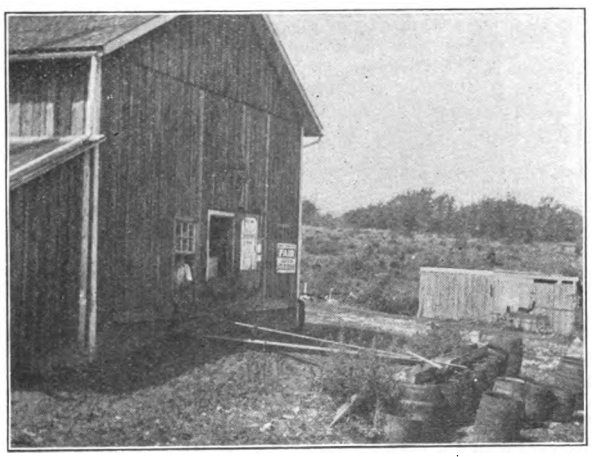

FIG. 9.—Patron's whey barrels at a Wisconsin Swiss-cheese factory.

Neither of these two samples of whey butter had been salted, but they, together with the samples obtained at the other factory where the old process of whey butter making was used, show that such butter contains from twenty to thirty per cent of water, while in the separator whey butter between sixteen and seventeen per cent of water was found.

The difference in water content between the two kinds of whey butter will, of course, help out the yield of butter made by the old process; but even though it contains from five to fifteen per cent more water than the separator butter, this difference is overcome by the increased efficiency of skimming by the separator which recovers more butter fat and the butter sells for a higher price.

LOSSES IN CHURNING.

A still larger yield of butter can undoubtedly be obtained by both the cold and the separator processes of skimming the whey if some arrangement is provided for cooling the cream

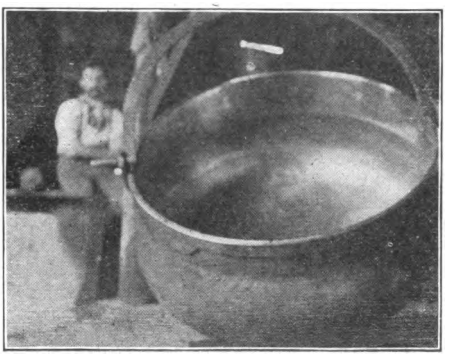

FIG. 10.—An open-fire kettle.

to a temperature of at least 55° F. before churning it. A large loss of butter fat in the buttermilk has always been found, even at the factories where separators are used. The only method of cooling the cream that seems to be known to the Swiss cheese maker is to add a large quantity of cold water to the cream in the churn. This was done at all the factories visited and while it cools the cream somewhat, it is not sufficient to reduce the losses in the buttermilk which, even after this excessive dilution, tested one per cent butter fat at all the factories. This is an unnecessary loss which can be overcome by thoroughly cooling the cream before churning it.

DISPOSAL OF THE WHEY.

At one factory where a separator was used the skimmed whey was pumped into a storage tank inside the factory; from this the farmers helped themselves by means of a large rubber hose which delivered the whey into their cans in the same way as skim milk is distributed at a creamery.

The whey when separated is hot and the cooking which the milk receives during the cheese making process pasteurizes it to a certain extent. This aids greatly in keeping the whey sweet and if the tank into which it is pumped from the separator is kept clean, the whey will remain in a sweet condition until delivered to the farmers.

A test of the whey as it was being run into the farmers' cans at the factory, where a separator and whey storage tank were used, showed that the whey contained nineteen hundredths (.19) per cent acidity.

At another factory where a separator was used, the skimmed whey was run into whey barrels outside the factory. This whey was not so sweet when the farmers took it away as that stored in the tank. A test showed that the separator skimmed whey in the barrels had forty-five hundredths (.45) per cent acidity when the farmers were dipping it into their cans to take home.

The whey at both factories had stood about eight hours in the tank and barrels and the difference in acidity was due to the fact that the barrels were only cleaned once a week by the farmers, while the whey storage tank was cleaned every day by the cheese maker.

At the factory where the skimming was done by the cold process the whey contained seven-tenths (.7) per cent acidity when the farmer received it.

These observations show that by separator-skimming, the whey may be returned to the farmers perfectly sweet, and their cans need not be contaminated with the many objectionable ferments which are contained in the sour whey usually received when skimming is done by the old processes.

Mild complaints are sometimes made of the diminished feed-

ing value of the separator-skimmed whey because it contains less butter fat than the old-process whey, but the separator whey, being sweet, is more valuable than the fat in the old-process whey because of the protection given against contamination of the milk delivered to the factory in the same cans used to return the whey to the farm. Many defects in the cheese and losses from a poor quality of cheese are undoubtedly caused by returning sour whey to the farm in the patrons' milk cans, and the saving to the patrons of these losses by returning sweet whey will undoubtedly amount to enough to pay for several separators.

OBJECTIONS TO THE SEPARATORS.

The objections usually made to the use of separators for skimming the Swiss whey are, the cost of the separator and the increased amount of fuel needed to keep up sufficient steam to run the engine which furnishes power for the separator. At one factory visited the cheese maker estimated that the increase in his fuel bill since using a separator over what it formerly was would amount to $100 for the season. This seems like a large sum, but if the amount of whey butter made and sold is doubled by the superior skimming of the separator and the price of the butter increased several cents per pound, the increased returns will undoubtedly be considerably larger than the increase in the fuel bill, and when a whey tank is used instead of whey barrels, the cheese maker is much more sure of making cheese which will grade number one during the entire season than he is when the sour whey is kept in dirty barrels and taken home by the farmers in the same cans they use for bringing milk to the factory.

It is true that for the cheese making alone, very little fuel is needed, as the milk when it arrives at the factory is still warm and a little fire will keep it up to the required temperature for making the cheese. The fuel ordinarily used at a Swiss factory does not amount to very much unless the whey is boiled for separating the cream by the hot process, or a boiler is used to furnish steam for an engine to run the separator.

The amount of fuel can undoubtedly be greatly reduced if the boilers are bricked in or enclosed in such a way as to save a great deal of the heat ordinarily lost by radiation. At most cheese factories it is customary to set up the boiler in one corner of the cheese-making room without protecting it in any way. This practice is very likely caused by the fact that the cheese maker may have to move his machinery at the end of the season.

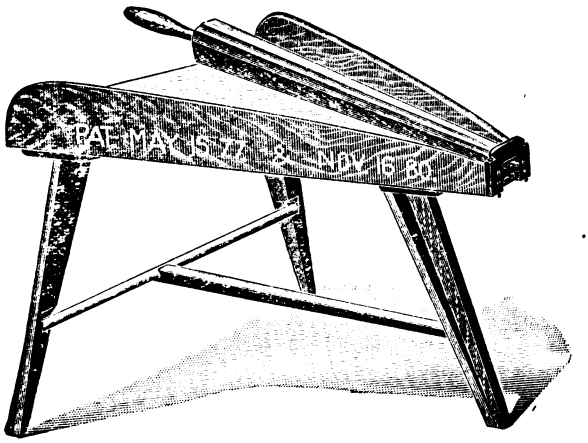

FIG. 11.—Hand lever butter worker.

USE OF GASOLINE ENGINES.

A large amount of the fuel needed for skimming can undoubtedly be saved by using a gasoline engine. One factory was visited where a small gasoline engine furnished power to run the stirrer in the cheese kettle and to do the churning, but no place has been heard of where gasoline engines have been tried for running a separator. This power would doubtless reduce the expense of fuel at the factories. The suggestion is certainly worth considering by parties intending to use a separator for skimming whey.

The cost of a power separator capable of efficiently skimming the whey at a Swiss cheese factory doubtless prevents their use at a great many places. This fact is of considerable importance to the cheese maker who buys all his own machinery

and who is more or less uncertain about remaining at a factory longer than one year. If he must move all his belongings each year he will be inclined to accumulate the least amount of machinery possible to make the cheese.

The observations which have been made, however, show that by using improved methods of skimming and churning a separator can be more than paid for in one year with the surplus whey butter made, even if the price received for it is not much greater than that paid for the old process whey butter. The records of one factory may be given to illustrate these points. The total milk received during one season was 665,292 pounds; the cheese made, 60,543 pounds; and the whey butter sold, 3,323 pounds. This whey butter was all made by the old process and $412 was received for it. This is an average of 12.4 cents per pound for the whey butter, which is rather a high price, but the butter market was above the average that year. If the amount of whey butter was doubled and no higher price received for it, the extra $412 would more than pay for a good separator. From the observations made it seem easily possible to double the amount received for whey butter by skimming with a separator and making butter of a better quality. The pounds of butter made have already been increased one-half as was shown at the two factories where twenty-three and one-half and thirty-eight pounds of whey butter were obtained from about the same amount of milk in one day, the former making whey butter by the old process and the latter using a separator to skim the whey. This is an increase of fourteen and one-half pounds of butter per day, or a little over sixty per cent by skimming with a separator. If in addition to this the price of the separator butter is increased several cents per pound, the account will stand very much in favor of the improvements suggested, which include a separator, better cooling of the cream and sweet whey from a whey storage tank.

SUGGESTIONS FOR IMPROVING WHEY BUTTER.

The milk received at Swiss cheese factories is usually fresh and sweet when delivered and the hot whey (temperature 130° F.) is commonly obtained from it within five hours of the time the cows are milked. These are certainly favorable conditions for clean skimming and an easy ripening of the cream. Many creamery butter makers would consider themselves fortunate if they were sure of receiving from farms where hand separators are used so good a quality of cream as may be obtained from Swiss whey.

If it pays to make whey butter at all it will certainly pay to make the most and the best butter possible.

An effort to improve the whey butter has already been made at some factories, and the following suggestions may be helpful to them and to others wishing to introduce changes in their methods.

SKIMMING THE WHEY.

The cold process of skimming whey ought to be abandoned as the butter obtained by it is of very inferior quality and the sour whey, after skimming, is a dangerous product which may be responsible for large losses in the cheese. The undesirable fermentations left in this whey may so contaminate the patrons' milk cans that the new, fresh milk brought to the factory in the same cans will be spoiled for cheese making.

FIG. 12.—A butter packer.

The hot process of skimming the whey is far superior to the cold process, as a sweet whey may be given to the patrons and a large proportion of the butter fat recovered; but the continued heating of the whey necessary to separate the cream by this process destroys the body of the butter and gives a large quantity of thin cream which must receive considerable attention to make good butter.

Skimming the whey with a centrifugal separator is the best way known at the present time. A machine having a capacity of at least 2000 pounds per hour is usually large enough. Separators will skim more whey than milk as the whey skims easier and its temperature is favorable for skimming large quantities efficiently.

The separator should be carefully selected. Do not buy an old-fashioned, heavy bowl separator because it is cheap. Modern machines that have been used somewhat and require a minimum amount of power to run them, can often be bought at a reasonable price.

If wood is scarce and high priced, a gasoline engine makes an economical power for separating, churning, etc. A three horse power engine ought to be large enough to run a separator, but one of greater power may be more economical. Turbine cream separators will probably skim the whey economically, but since some power is needed at the factory a belt separator may be run by a steam or gasoline engine. Small steam engines, however, are often very wasteful of steam and are sometimes responsible for large fuel losses which may be erroneously charged to the separator.

The whey should be skimmed while it is hot and the skimming regulated so that the cream finally obtained will test about thirty per cent fat.

A Babcock tester is a valuable detective to have when making butter, and the separator-skimmed-whey should be frequently tested.

Do not fail to thoroughly test a separator for power or fuel required to run it and inspect the efficiency of its skimming by frequent tests of the skimmed whey.

The whey can be pumped directly from the kettle to the separator and the skimmed whey pumped into a storage tank from which the patrons may fill their cans. The whey storage tank should be cleaned daily.

RIPENING THE CREAM.

Cream, like milk and butter, will easily absorb odors from the surrounding atmosphere, and on this account a cheese curing cellar is not a good place in which to keep cream. A cream ripening can or vat of some sort is always necessary for making butter and the wooden tub used for this purpose

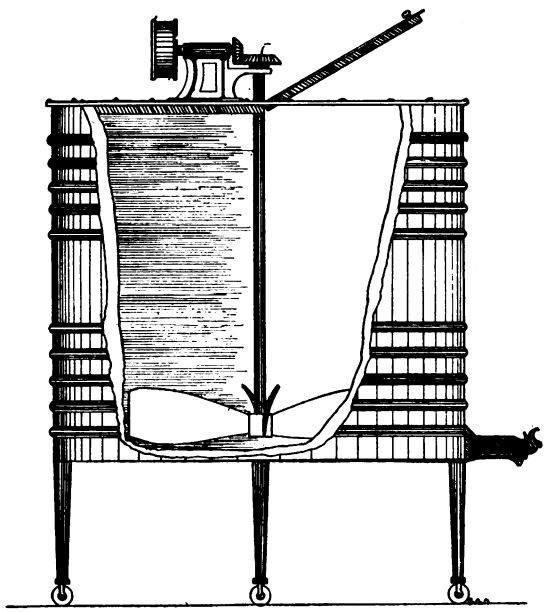

FIG. 13.—A cream ripening vat.

by the cheese maker should be abandoned. A tin can set in a barrel or a tank of water may be successfully used for a cream ripening receptacle, but the cream should be stirred and its temperature regulated as the ripening progresses. Any arrangement that will afford a way of stirring and cooling the cream rapidly and then hold it at a cold temperature is all that is needed for ripening the cream. Small amounts of cream can be handled in milk cans and a long handled tin

dipper or tin disc used for a stirrer, the can being placed in a tub or tank of cold water.

Where enough butter is made to churn regularly it will undoubtedly be found economical to use some sort of a permanent cream ripening vat. A tin vat inside a wooden tank with an ice box at one end is very convenient and not expensive. A cover of light cloth of some sort should be provided for it and if no ice is available the ice chamber may be filled with cold water which, by circulating around the vat will aid in holding the cream at a desired temperature. A tin dipper with a long handle may be used to stir the cream in the vat. Wooden stirrers are not satisfactory.

The modern starter-can, used by the creamery butter maker, would make a very satisfactory cream vat for a Swiss cheese

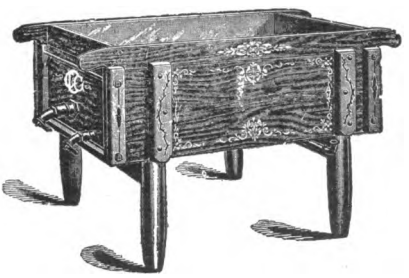

FIG. 14.—A cream ripening vat. This should be provided with a water jacket such as is used in vats made with an icebox at one end.

factory. These cans contain a power stirrer and a water jacket making it very easy to control the temperature of the cream held in them.

Cream should be held some two hours or more after ripening at a temperature between 50° and 55° F. before churning. This will harden the butter fat, improve the body of the butter and aid in getting an exhaustive churning.

MAKING AND USING A STARTER.

The cream in sweet whey has been so thoroughly heated during the cheese making process that a starter of some kind is often necessary to aid in ripening it. This starter can be

made by setting some fresh, whole milk selected from a patron having fresh cows, in a clean can at a temperature of about 70° F. until it is sour. The best time to use this sour milk is just before or soon after it coagulates. Sour milk that has "wheyed off" is not safe to use as a starter because the curd in it may be too hard to break up readily when added to the cream.

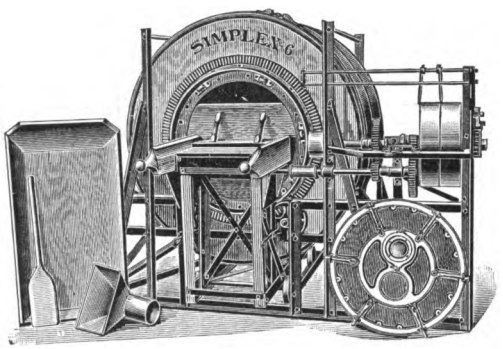

FIG. 15.—A combined churn and worker.

The odor of the starter should be carefully inspected before adding it to the cream and when objectionable flavors are noticed the starter should be thrown away.

About ten to fifteen pounds of starter per hundred pounds of cream may be safely used when the cream is churned every day; the amount of starter being regulated by the rate at which the cream ripens.

CHURNING THE CREAM.

The daily routine of churning at a Swiss cheese factory may be arranged on the following plan: Churning is usually, though not necessarily, done in the morning.

The morning whey, we will assume, is skimmed at 11:00 A. M. The fresh, sweet cream obtained, may have a temperature of 90° F. This cream should be placed in the ripening can or vat at once and the soft, curdled, sour-milk starter, previously prepared, added to it. After thorough

mixing, cool the cream slowly to about 70° F. and hold near this temperature until nearly five-tenths per cent acidity has developed. When this point is reached cool at once to near 50° F. and maintain this temperature until the cream from the night skimming of whey is obtained.

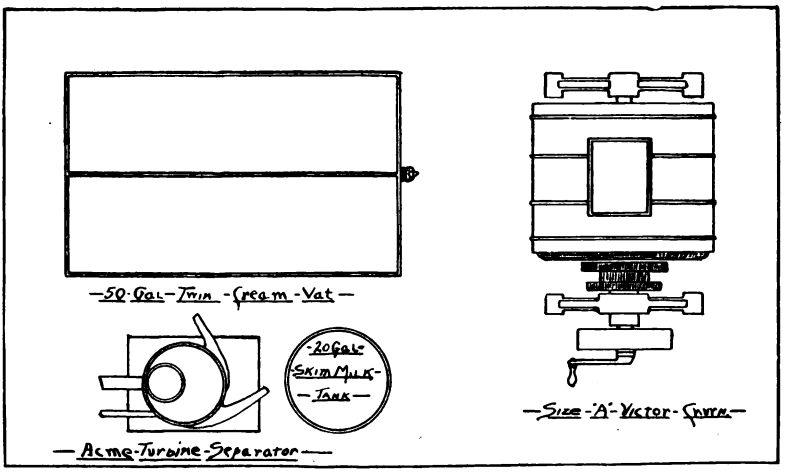

FIG. 16.—Plan showing floor space required for a butter making outfit.

The second skimming of whey-cream, which in this case is from the night's milk, should be cooled below 90 degrees F. and then it may be added to that of the previous skimming already partially ripened, and the two lots mixed in the can or vat, leaving them at a temperature near 70° F. for the remainder of the night. In the early morning examine the cream, testing its temperature and acidity and when it has reached nearly six-tenths (.6) per cent acidity, the cream must be cooled as quickly as possible to 50° F. or lower. It should be held at this temperature for at least two hours; a longer time will do no harm and may be beneficial.

Cream should have a thick body, like whipped cream, when it is ready to churn; this comes with age and with the cooling after ripening. If the cream is thin and not sour enough, it will not churn readily and there may be a large loss in the buttermilk. When the cream is allowed to stand too long and be-

comes so sour that whey separates from it, the flavor of the butter may be injured by this over-ripeness.

Cream should be stirred frequently during the time it is ripening; this will aid in getting a uniform ripening and an exhaustive churning.

Cream is in good condition to churn when it has an acidity of six-tenths per cent and a temperature of about 50° F. Churning usually requires about one hour and should be stopped when the butter granules are about the size of wheat grains. When the cream is not sufficiently ripened, or it is churned too warm, there may be an excessive loss of butter in the buttermilk.

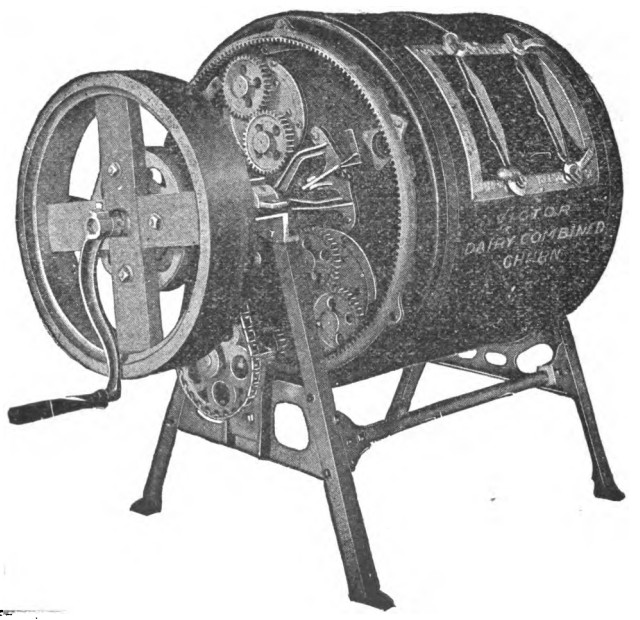

FIG. 17.—A combined churn and worker.

THE CHURN.

Barrel churns are used a great deal in whey butter making, and either these or a small factory box churn will do satisfactory work. If a churn has become tainted, as is often the case when it has been used for churning old process whey cream,

an effort should be made to sweeten it. The cheesey odor which sometimes clings to whey butter churns will easily contaminate good cream and impart an objectionable flavor to the butter. This taint can not often be removed and churns having it should be discarded.

Some churn-taints may be removed by churning milk-of-lime and allowing this to stand over night in the churn, but one that is badly tainted can not be entirely sweetened by this or any other treatment.

A clean, sweet smelling churn is absolutely necessary for making good butter.

Small combined churns and workers would be very convenient and satisfactory to use in whey butter making as the butter can be left in them after churning and the butter working done at convenient times while the cheese maker may be occupied with other work. A few revolutions of the churn with an interval between workings for the salt to dissolve, is just what is needed to get the butter evenly salted and satisfactorily worked.

THE BUTTER WORKER.

A homemade lever butter worker can be used if desired for small quantities of butter. The granular butter should be washed in the churn after the buttermilk is drawn off, and when well drained taken out with wooden ladles. The butter is placed in the worker, then sprinkled with butter salt, one ounce to the pound (cheese salt is too coarse), and well mixed by means of the wooden ladles. The lever is then used to press out the buttermilk and the working continued until a clear brine flows from the worker. A little working at a time is better than doing all the working at once. If the butter becomes soft on the worker, cold water may be poured over it but this will wash out some of the salt and possibly a little flavor.

The combined churn and worker, already mentioned, is a satisfactory machine and can be conveniently used in making whey butter.

Working butter on a cheese board by hand is not to be recommended as bad flavors may be taken up by the butter and

its body injured by the scraping it receives when worked in this way.

When butter color is needed it should be added to the cream at the time it is put into the churn.

The tubs of finished butter should be kept in a cool place and not left uncovered in the cheese cellars. Butter ought to be shipped to market soon after it is made and not held more than a few days.

SUMMARY.

1. A good quality of sweet cream can be obtained by skimming Swiss cheese whey with a centrifugal cream separator.

2. The whey often tests one per cent butter fat and has a temperature of 120° F. when the cheese is taken from the kettle.

3. The amount of whey butter made at Swiss cheese factories can be greatly increased by skimming with a separator and ripening and churning the cream so as to reduce the usual large losses in the skim milk and the buttermilk.

4. The quality and the water-content of separator whey butter may be made equal to that of creamery butter, as the cream obtained by skimming the whey is sweet and need not contain any objectionable flavors.

5. When a separator, cream ripening vat and combined churn are installed at a Swiss cheese factory, the winter milk may be made into butter instead of closing the factory, if the patrons so desire.

6. The amount of fuel required at a Swiss cheese factory is increased by skimming the whey with a separator, but this can be reduced by enclosing the boiler with brick and by using a modern separator.

7. A separator can be run by a gasoline engine and the sweet cream from a number of factories collected and churned at one place, thus saving the work of cream ripening and churning at each factory.

8. When all the butter making operations are carried on at a Swiss cheese factory the following machines and appliances are needed:

a. A modern turbine or belt cream separator that requires a small amount of fuel or power to run it, and one that will skim efficiently at least 2000 pounds of whey per hour.

b. A covered cream can or vat in which the cream can be readily cooled and kept cool by using cold water or ice. A wooden tub for holding the cream is not satisfactory.

c. A few two or three gallon cans for collecting sweet milk. (This milk is allowed to sour and then added to the cream as a starter.)

d. A thermometer, butter color, butter salt, butter ladles and packers, apparatus for testing the acidity of cream, and a Babcock tester with glassware, including two double-neck test bottles for testing the skimmed whey, and two cream bottles for testing cream; a barrel churn and lever butter worker or a combined churn and worker.

9. Churning every day is better than accumulating cream several days before churning it.

10. A cheese cellar is not a good place in which to keep cream or butter; a cool, dry room or refrigerator should be provided for this purpose.

11. Cheese salt is too coarse for salting butter; butter salt and butter color ought to be used.

12. The skimmed whey should be stored in a tank from which it can be drawn into the patrons' cans by means of a hose. The whey storage tank should be cleaned every day. Whey barrels should be abandoned.

13. The butter value of the butter fat in whey is greater that its pig- and calf-feeding value. Two pounds of corn meal contain nearly as much food energy as one pound of butter fat.